



**COLORADO NATIONAL
LEASING, INC.**

January 7, 1991

Secretary
Interstate Commerce Commission
Washington, D.C. 20423

17206
JAN 17 1991 -4 44 PM
INTERSTATE COMMERCE COMMISSION

Dear Secretary,

I have enclosed an original and one copy of the document described below, to be recorded pursuant to Section 11303 of Title 49 of the U.S. Code.

This document is a Loan and Security Agreement, a primary document dated December 20, 1990.

The names and addresses of the parties to the document are as follows:

Secured Party: Colorado National Leasing, Inc.
950 17th St., Ste. 2400
Denver, Colorado 80202

Debtor: Sstech Railway Technology
P.O. Box 104
Guernsey, Wyoming 82214

A description of the equipment covered by this document is as follows:
Primary test vehicle 9007, a self-propelled, diesel-powered, fully thermally insulated, heated and air-conditioned 4-wheel vehicle;
TV 2 HJ60 Toyota, with complete instrumentation package for the continuous testing of rails for fatigue flows; TV 3 Ford Centurion Classic 150 4WD, with complete instrumentation for the continuous testing of rails for fatigue flows.

A fee of \$ 15.00 is enclosed. Please return the original and any extra copies not needed by the Commission for recordation to Colorado National Leasing, Inc., 950 17th St., Ste. 2400, Denver, CO 80202. A short summary of the document to appear in the index follows: Loan and Security Agreement between Colorado National Leasing, Inc., Secured Party, 950 17th St., Ste. 2400, Denver, CO 80202 and Sstech Railway Technology, Debtor, P.O. Box 104, Guernsey, WY 82214, and covering one Primary test vehicle 9007, one TV 2 HJ60 Toyota, and one TV 3 Ford Centurion Classic.

Very truly yours,
Colorado National Leasing, Inc.

By Terri De Herrera
Terri De Herrera, Leasing Officer

Interstate Commerce Commission
Washington, D.C. 20423

1/24/91

OFFICE OF THE SECRETARY

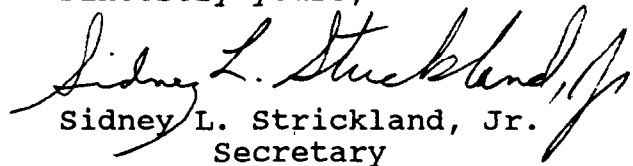
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Terri De Herrem
Leasing Officer
950 Seventeenth Street
Suite 2400
Denver, Colorado 80202

Dear Sir:

The enclosed document(s) was recorded pursuant to the provisions of Section 11303 of the Interstate Commerce Act, 49 U.S.C. 11303, on 1/17/91 at 4:10am, and assigned recordation number(s). 17206 & 16161-A

Sincerely yours,


Sidney L. Strickland, Jr.
Secretary

RECORDED NO 17206 FILED NO
JAN 17 1991 4:12 AM
INTERSTATE COMMERCE COMMISSION

LOAN AND SECURITY AGREEMENT

BY AND BETWEEN

SSTECH RAILWAY TECHNOLOGY,
a Wyoming limited liability company,

as Borrower,


AND

COLORADO NATIONAL LEASING, INC.,
a Colorado corporation,

as Lender.

Made as of the 20th day of December, 1990

State of Colorado, County of Denver, I, Terri De Herrera, a Notary Public in and for said state, do hereby certify that on January 7, 1991, I carefully compared with the original the attached facsimile of the Loan and Security Agreement and the facsimile I now hold in my possession. They are complete, full, true and exact facsimiles of the document they purport to reproduce.


Notary Public

My Commission expires 1-31-94

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LOAN AND SECURITY AGREEMENT

THIS LOAN AND SECURITY AGREEMENT (this "Agreement") is made as of the 20th day of December, 1990, by and between SSTECH RAILWAY TECHNOLOGY, a Wyoming limited liability company, ("Borrower"), and COLORADO NATIONAL LEASING, INC., a Colorado corporation ("Lender").

RECITALS

A. Borrower has requested that Lender extend to Borrower a loan (the "Loan") in the principal amount of \$1,200,000.00; and

B. Lender is willing to make the Loan to Borrower, upon the terms and conditions hereinafter set forth.

NOW THEREFORE, in consideration of the agreements set forth herein, and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Lender and Borrower hereby agree as follows:

ARTICLE I

CERTAIN DEFINITIONS

The following terms shall have the meanings set forth below:

Section 1.1 Accounts. All of Borrower's accounts, contracts and contract rights, whether now owned or hereafter acquired, arising out of or in any way relating to the use, rental and operation of the Vehicles, including, without limitation, all accounts, contracts and contract rights arising from the Burlington Northern Agreement, and including all proceeds of such accounts, contracts and contract rights and all records relating thereto.

Section 1.2 Borrower. SSTECH Railway Technology, a Wyoming limited liability company.

Section 1.3 Burlington Northern Agreement. Equipment Rental Agreement dated August 8, 1989, between Borrower and Burlington Northern Railroad Company, as amended by letter agreements dated November 10, 1989 and June 1, 1990.

Section 1.4 Business Day. Any day when Lender's offices are open for business in Denver, Colorado.

Section 1.5 Cash Deposit. The cash deposit described in Section 3.3 of this Agreement.

Section 1.6 Closing. The date of initial disbursement of proceeds of the Loan.

Section 1.7 Collateral. The meaning assigned to such term in Section 3.1 of this Agreement.

Section 1.8 Current Assets. All assets that should, in accordance with GAAP, be classified as Current Assets on Borrower's balance sheet, but excluding therefrom (a) any amounts owing to Borrower by any of its members, managers, officers or employees and (b) accounts receivable.

Section 1.9 Current Liabilities. All liabilities that should, in accordance with GAAP, be classified as Current Liabilities on Borrower's balance sheet.

Section 1.10 Default Rate. A rate equal to sixteen and one-half percent (16.50%) per annum.

Section 1.11 ERISA. Employee Retirement Income Security Act of 1974, as amended from time to time.

Section 1.12 Events of Default. The current existence of any of the conditions or circumstances described in Section 7.1 hereof.

Section 1.13 Financing Statements. The financing statements described in Section 3.2(d) hereof.

Section 1.14 GAAP. Generally accepted accounting principles applied consistently, with such changes or modifications thereto as may be approved in writing by Lender. Accounting terms used and not otherwise defined in this Agreement have the meanings determined by, and all calculations with respect to accounting or financial matters unless otherwise provided herein shall be computed in accordance with, GAAP.

Section 1.15 General Intangibles. All general intangibles of Borrower that relate in any way or might be utilized in connection with or benefit the Vehicles, including, without limitation, (a) permits, authorizations and approvals presently and hereafter issued by any federal, state, municipal or local governmental or regulatory authority in connection with any of the Vehicles; (b) all presently existing and hereafter created contracts, leases, licenses and agreements pertaining to

the ownership, management, leasing, maintenance or operation of any of the Vehicles; (c) all presently and hereafter existing policies and agreements of insurance issued in favor of Borrower in connection with any of the Vehicles; (d) all copyrights, chattel paper, licenses, money, insurance proceeds, contract rights, subscription lists, mailing lists, licensing agreements, patents, trademarks and tradenames relating to or used in connection with the Vehicles; (e) all computer programs, computer software and other electronic systems and materials of any kind relating in any way to the Vehicles or the operation thereof; and (f) all other presently existing and hereafter acquired documents, accounts, general intangibles and intangible personal property of any kind, and all rights, interests and liens held by Borrower thereunder, arising out of the acquisition, maintenance, financing, leasing, operation or other use of the Vehicles.

Section 1.16 Guarantors. Collectively, Donald S. Searle and Peter Tyler.

Section 1.17 Guaranties. Guaranty Agreements dated of even date herewith, whereby Guarantors unconditionally guarantee payment in full of a portion the Obligations, as more fully described in Section 3.4 hereof.

Section 1.18 Guaranty Amount. The meaning assigned to such term in Section 3.4 hereof.

Section 1.19 Indebtedness. As to Borrower, all items of indebtedness, obligation or liability, whether matured or unmatured, liquidated or unliquidated, direct or contingent, joint or several, including, without limitation, the Obligations.

Section 1.20 Lender. Colorado National Leasing, Inc., a Colorado corporation.

Section 1.21 Loan Documents. Collectively, this Agreement, the Note, the Security Agreement, the Guaranties, the Financing Statements and any other documents required or contemplated by this Agreement or executed in connection with the Loan.

Section 1.22 Net Worth. At any time, Borrower's total Assets (excluding therefrom any amounts owing to Borrower by any of its members, managers, officers or employees) less Borrower's total Liabilities.

Section 1.23 Note. The promissory note described in Section 2.1 of this Agreement.

Section 1.24 Obligations. All obligations of Borrower:

(a) To pay the principal of and interest on the Note in accordance with the terms thereof, to pay all other amounts that Borrower is required to pay under this Agreement or the Note, and to satisfy all of its other liabilities to Lender, whether hereunder or otherwise, whether now existing or hereafter incurred, matured or unmatured, direct or contingent, joint or several, including any extensions, modifications or renewals thereof and substitutions therefor;

(b) To repay to Lender all amounts advanced hereunder or otherwise on behalf of Borrower, including, without limitation, advances for taxes, levies or insurance on the Vehicles, whether advanced from the Cash Deposit or any other funds; and

(c) To reimburse Lender, on demand, for all of Lender's reasonable expenses and costs, including the fees and expenses of its counsel, in connection with the negotiation, preparation, execution, delivery, filing, recordation, administration, amendment, modification or enforcement of the Loan Documents, including, without limitation, any proceedings brought, or threatened, to enforce payment of any of the obligations referred to in the foregoing paragraphs (a) and (b).

Section 1.25 Ownership Interests. At any time, the aggregate right, title and interest of all of Borrower's members to all profits, losses, distributions, credits, income, gain, loss, deduction (or items thereof) and any and all rights to appreciation in Borrower's assets and any and all interest in Borrower's capital, including, but not limited to, all rights of the members to be repaid their respective contributions of money or other property to Borrower, whether made at the time of formation of Borrower or subsequent thereto.

Section 1.26 Primary Vehicle. SSTECH rail flaw detection car 9007, more particularly described on Exhibit A attached hereto and incorporated herein by this reference.

Section 1.27 Security Agreement. Security Agreement dated of even date herewith, whereby Borrower grants Lender a first priority security interest in the Test Vehicles.

Section 1.28 Test Vehicles. Together, a 1989 Toyota Landcruiser Wagon (designated as TV2) and a 1990 Ford Centurion Classic Bronco Wagon (designated as TV3), all as more particularly described on Exhibit B attached hereto and incorporated herein by this reference.

Section 1.29 Vehicles. Collectively, the Primary Vehicle and the Test Vehicles.

ARTICLE II

AMOUNT AND TERMS OF THE LOAN

Section 2.1 Amount of the Loan. Lender agrees, on the terms and conditions set forth in this Agreement, to make a Loan to Borrower in the principal amount of One Million Two Hundred Thousand and No/100 Dollars (\$1,200,000.00). Concurrently with Lender's advance to Borrower of proceeds of the Loan, Borrower shall execute and deliver to Lender a promissory note in the stated principal amount of \$1,200,000.00, bearing interest and payable as provided in this Agreement, and otherwise in form and substance satisfactory to Lender.

Section 2.2 Term. The term of the Loan shall commence as of the date of this Agreement. Payments shall be made in accordance with Section 2.4 hereof, and, if not sooner paid, the entire unpaid principal indebtedness, all accrued and unpaid interest, and all other sums payable in connection with the Loan shall be due and payable on January 10, 1996, or such earlier date as may result from Lender's acceleration of the Loan upon the occurrence of an Event of Default.

Section 2.3 Interest Rate. The Loan shall bear interest on the outstanding principal balance thereof from the date funds are advanced until the Loan is paid in full at a rate equal to twelve and one-half percent (12.50%) per annum prior to maturity or the Default Rate after maturity, whether maturity is brought about by acceleration upon an Event of Default or otherwise.

Section 2.4 Repayment. The Loan shall be payable as follows:

(a) At Closing, Borrower shall make a payment of interest only, in advance, in the amount of \$7,916.67, for the period from Closing through January 9, 1991.

(b) On January 10, 1991 and February 10, 1991, Borrower shall make payments of principal and interest in the Loan in equal monthly installments of \$21,271.00, to be applied as follows:

(i) first, to the payment of interest on the Loan, in advance for the period from such payment date through the ninth day of the next succeeding calendar month, computed on the basis of a 360-day year, calculated for

the actual number of days in such period;
and

- (ii) second, to reduction of principal of the Loan.

(c) Commencing March 10, 1991, and continuing on the tenth day of each month thereafter, Borrower shall make payments of principal of and interest on the Loan in equal monthly installments of \$24,437.94, to be applied as follows:

- (i) first, to the payment of interest on the Loan, in advance for the period from such payment date through the ninth day of the next succeeding calendar month, computed on the basis of a 360-day year, calculated for the actual number of days in such period;
and
- (ii) second, to reduction of principal of the Loan.

(d) The entire unpaid principal balance of the Loan, together with all accrued interest thereon and all other amounts payable thereunder, shall be due and payable in full on January 10, 1996.

Section 2.5 Prepayment. Upon ten (10) days' prior written notice to Lender, Borrower may prepay the Loan in whole or in part. No partial prepayment shall relieve Borrower of the obligation to pay future installments of principal or interest when due hereunder. No amount which has been prepaid shall thereafter be available for borrowing again at a later time.

Section 2.6 Payments. Borrower shall make each payment due under any Loan Document not later than 11:00 a.m. (Denver time) on the day when due in lawful money of the United States of America to Lender at its address set forth in Section 8.2 hereof in immediately available funds.

Section 2.7 Payments on Non-Business Days. Whenever any payment to be made hereunder or under the Note shall be stated to be due on a day other than a Business Day, such payment may be made on the next succeeding Business Day.

Section 2.8 Deposit; Loan Costs.

(a) Lender acknowledges that Borrower has previously paid to Lender a good faith deposit in the amount of \$5,000.00. Borrower agrees that in the event Closing does not occur on or before January 15, 1991, Lender shall be entitled to

retain such deposit and apply it in such manner as Lender may determine in its sole discretion. In the event Closing does occur on or before such date, such deposit shall be applied (i) first, toward payment of Lender's costs and expenses as described in subsection 2.8(b) below, (ii) second, toward payment of the interest payable at Closing pursuant to subsection 2.4(a) above, and, (iii) third, toward payment of such other items as Lender may determine in its sole discretion.

(b) Borrower hereby agrees to pay the following fees to Lender and to reimburse Lender for the following costs and expenses:

- (i) All reasonable costs and expenses incurred by Lender in connection with the negotiation, preparation, execution, delivery, filing, recordation and administration of all the Loan Documents, including, without limitation, attorneys' fees and expenses.
- (ii) All reasonable costs and expenses of any kind, including, without limitation, all attorneys' fees and expenses that Lender might incur in connection with the amendment, modification or enforcement of any of the Loan Documents and the exercise of Lender's rights thereunder.

Section 2.9 Use of Loan Proceeds. At Closing, the proceeds of the Loan shall be disbursed as follows:

(a) Such amount as Lender may deem necessary or desirable in its sole discretion shall be retained by Lender to be applied toward payment in full of any liens which encumber the Test Vehicles as of Closing. Lender shall have no obligation to disburse Loan proceeds for payment of any such liens until Lender shall have received such assurances as Lender deems necessary in its sole discretion that upon disbursement of such Loan proceeds, Lender will receive the original vehicle titles for the Test Vehicles, free from all liens whatsoever.

(b) After payment of the amounts specified in subsection 2.9(a) above, the balance of the Loan proceeds shall be disbursed to Borrower.

ARTICLE III

SECURITY FOR THE LOAN

Section 3.1 Security for the Loan. As security for Borrower's payment of the Obligations, and for performance by Borrower of all its obligations under this Agreement, Borrower hereby grants, transfers, conveys and assigns to Lender, and its successors and assigns, a first priority security interest in and to all of the following described property and all of Borrower's right, title and interest therein (collectively, the "Collateral"):

- (a) the Vehicles;
- (b) the Accounts;
- (c) the Burlington Northern Agreement;
- (d) the Cash Deposit;
- (e) the General Intangibles; and

(f) Any and all present and further accounts, general intangibles, chattel paper, accessions, replacements, betterments and substitutions for any of the property described in subsections 3.1(a) through 3.1(e) above, and all proceeds arising from or by virtue of, or from the sale or disposition of, or collections with respect to, or claims against any other persons, corporations or other entities with respect to, or insurance proceeds payable with respect to, or claims against any other persons, corporations or other entities with respect to, all or any part of the foregoing described property and interests.

Section 3.2 Security Documents. Borrower shall execute and deliver, or cause to be executed and delivered, to Lender the following:

- (a) Guaranties. The Guaranties.
- (b) Security Agreement. The Security Agreement.
- (c) Test Vehicle Titles. The original vehicle titles for the Test Vehicles. Borrower shall take all actions which Lender may request in order to perfect Lender's first priority security interest in the Test Vehicles.
- (d) Financing Statements. Financing statements on form UCC-1 or such other form as Lender may require, in proper form to be duly filed under the Uniform Commercial Code, or other

laws, of all jurisdictions as may be necessary or, in the reasonable opinion of Lender, desirable to perfect the security interests created by this Agreement and the other Loan Documents.

(e) Other Collateral Assignments. Such collateral assignments of agreements, contracts, documents, permits, licenses, certificates and/or instruments relating to the Vehicles and their operation as Lender may require.

Section 3.3 Cash Deposit.

(a) At Closing, Borrower shall deposit with Lender cash or other immediately available funds satisfactory to Lender in the amount of \$552,500.00. Such deposit, together with all interest and other amounts that may be earned thereon from time to time, any and all accounts into which any portion of such deposit and any earnings thereon may be deposited, and any and all certificates and other instruments evidencing or relating in any manner to such deposit and earnings thereon are, collectively, the "Cash Deposit."

(b) While no further acts are required to create or perfect the security interest granted to Lender in the Cash Deposit pursuant to this Agreement, Borrower shall execute such additional security agreements, financing statements or other documents as Lender may request in order to evidence or perfect such security interest. Borrower agrees that possession of all or any portion of the Cash Deposit by third parties with whom Lender may deposit or to whom Lender may deliver the Cash Deposit shall constitute possession by Lender and shall perfect Lender's security interest in such amounts and that, for the purpose of establishing Lender's possession, such third parties shall be deemed to be Lender's bailee and agent.

(c) Borrower agrees that Lender may, and expressly authorizes Lender to, invest the Cash Deposit in such manner as Lender may deem desirable in its sole discretion. Notwithstanding the foregoing sentence, so long as (i) there exists no Event of Default and no event which, with the passing of time or the giving of notice, or both, would constitute an Event of Default, and (ii) Borrower has reimbursed Lender for any portion of the Cash Deposit expended in accordance with subsections 3.3(d) and 3.3(e) below, then Lender will, on the tenth day of each month during the term of the Loan, pay to Borrower interest on the principal portion of the Cash Deposit at a per-annum interest rate equal to the per-annum interest rate paid by The Colorado National Bank of Denver ("CNB") on 90-day, \$500,000 certificates of deposit. Such rate will be fixed at Closing for the first 90 days immediately succeeding Closing, and shall be adjusted every 90 days thereafter, based on the then

current market rate for 90-day, \$500,000 certificates of deposit issued by CNB. All interest payable on the Cash Deposit shall be deemed earned by Borrower, and shall be reported to the Internal Revenue Service and any other taxing authorities as income to Borrower. Borrower's tax identification number is 81-0464555.

(d) If Lender at any time reasonably determines that certain sums should be expended to preserve or maintain any of the Collateral, and to keep the same free from all liens and taxes (other than the security interests granted to Lender pursuant to this Agreement), Lender may (but shall not have any obligation to), without notice to Borrower (any such notice being expressly waived by Borrower), apply the Cash Deposit to the payment of such sums. If Lender applies any of the Cash Deposit to payment of such sums, Borrower shall immediately reimburse Lender for such amount, together with interest thereon at the Default Rate from the date of Lender's application thereof until paid.

(e) Without limiting Lender's rights under subsection 3.3(d) above, upon the occurrence and during the continuance of any Event of Default, Lender is hereby authorized at any time and from time to time, without notice to Borrower (any such notice being expressly waived by Borrower), to set off and apply all or any portion of the Cash Deposit against any and all of the Obligations of Borrower now or hereafter existing under the Loan Documents, irrespective of whether or not Lender shall have made any demand under this Agreement or the Note therefor and even though such Obligations may be unmatured.

Section 3.4 Guaranties.

(a) Each Guarantor must execute a Guaranty in form and substance satisfactory to Lender, unconditionally guaranteeing payment in full of a portion of the Obligations. Subject to subsection 3.4(b) below, the liability of each Guarantor under its Guaranty shall be limited to the amount of \$647,500.00 (the "Guaranty Amount"), notwithstanding that the Obligations may exceed \$647,500.00. Each Guarantor shall be jointly and severally liable with Borrower and with each other for payment in full of the Guaranty Amount. The liability of each Guarantor shall continue in effect until such time as the Obligations are reduced to zero. No reduction in the amount of Obligations, by reason of payments made by Borrower, proceeds received upon the disposition of Collateral, or from any other source, shall reduce the liability of Guarantors under their respective Guaranty Agreements until such time as, and then only to the extent that, the outstanding Obligations are less than the Guaranty Amount. If the outstanding Obligations are at any time less than the Guaranty Amount and the Lender thereafter makes additional advances to or on behalf of Borrower or interest

accrues on the outstanding Obligations, the liability of each Guarantor under its Guaranty Agreement shall be increased in the amount of such additional advances and interest (plus interest thereon), up to a maximum of the Guaranty Amount.

(b) Notwithstanding anything to the contrary in subsection 3.4(a) above, if any representation or warranty made by Borrower or any of its representatives under or in connection with any Loan Document shall prove to have been inaccurate in any material respect when made, and, as a result of such inaccuracy, Lender shall incur any loss, liability or expense whatsoever, each Guarantor will be fully, unconditionally, primarily and jointly and severally liable to Lender for all such losses, liabilities and expenses, without limitation.

ARTICLE IV

CONDITIONS OF LENDING

Section 4.1 Conditions Precedent to Loan. Lender's receipt of the following, in form and substance satisfactory to Lender and its counsel, shall be a condition precedent to Lender's obligation to make the Loan:

- (a) The Note;
- (b) The Security Agreement;
- (c) The Financing Statements;
- (d) The original vehicle titles for the Test Vehicles, and/or such assurances as Lender may deem necessary or desirable that such original titles will be delivered to Lender, free from all liens (except as created in favor of Lender hereunder);
- (e) The Guaranties;
- (f) The Cash Deposit;
- (g) All fees, costs and expenses required pursuant to Section 2.8(b) hereof;
- (h) Copies of Borrower's Articles of Organization and Operating Agreement, together with all amendments thereto;
- (i) Resolution of Borrower's members, authorizing the Loan and other transactions contemplated by the Loan Documents;

(j) Certificate of Good Standing for Borrower, issued by the Wyoming Secretary of State and dated within ten (10) days prior to the date of Closing;

(k) A bill of sale from Guarantors, evidencing their conveyance of fee title to the Primary Vehicle to Borrower;

(l) Such payoff letters, releases and other documents as Lender may require to ensure that Lender's security interest in the Vehicles is subject to no liens except the lien granted to Lender under the Loan Documents;

(m) Evidence of insurance satisfactory to Lender with respect to liability, casualty, collision and other policies of insurance required by Lender pursuant to Section 6.1(k) hereof, together with all endorsements to such policies as Lender may require; and

(n) Such other additional documents and information as Lender may reasonably request.

Section 4.2 Certain Events. At the time of Closing:

(a) No Event of Default shall have occurred and be continuing, and no event shall have occurred and be continuing that, with the giving of notice or passage of time, or both, would be an Event of Default;

(b) No material adverse change shall have occurred in the business prospects, financial condition or results of operations of Borrower since the date of the financial statements most recently provided to Lender;

(c) All of the documents described in Section 4.1 above shall be in full force and effect; and

(d) Each of the representations and warranties set forth in Section 5.1 hereof shall be true and correct in all material respects.

ARTICLE V

REPRESENTATIONS AND WARRANTIES

Section 5.1 Representations and Warranties of Borrower. Borrower represents and warrants to Lender as follows:

(a) Borrower is a limited liability company, duly organized, validly existing and in good standing under the laws of the State of Wyoming. Borrower is duly qualified to transact business as a foreign limited liability company, and is in good standing as a foreign limited liability company, in such other states as is required by law.

(b) Donald S. Searle owns forty-six percent (46%) of all Ownership Interests outstanding as of Closing, and Borrower anticipates that Peter Tyler will, as soon as practicable after December 31, 1990, acquire ten percent (10%) of all outstanding Ownership Interests.

(c) Donald S. Searle is the sole manager of Borrower.

(d) The execution, delivery and performance by Borrower of each Loan Document to which it is a party are within its powers and have been duly authorized by all necessary action.

(e) The execution, delivery and performance by Borrower of each Loan Document to which it is a party do not contravene any contractual restriction binding on or affecting it, and do not result in or require the creation of any lien, security interest, other charge or encumbrance (other than pursuant hereto) upon or with respect to any of its properties.

(f) No authorization or approval or other action by, and no notice to or filing with, any governmental authority or regulatory body is required for the due execution, delivery and performance by Borrower of any of the Loan Documents.

(g) This Agreement is, and each other Loan Document to which Borrower is a party will when delivered hereunder be, a valid and binding obligation enforceable against Borrower, in accordance with their respective terms, except as limited by equitable principles and bankruptcy, insolvency and similar laws affecting creditors' rights.

(h) Borrower has not made an assignment for the benefit of creditors, nor has Borrower filed, or, to the best of Borrower's knowledge had filed against it, any petition in bankruptcy.

(i) There is no pending or threatened litigation, action, proceeding or investigation against Borrower, or any of Borrower's properties, before any court, governmental or quasi-agency, arbitrator or other authority.

(j) Borrower is a "non-foreign person" within the meaning of Section 1445 of the United States Internal Revenue Code of 1986, as amended, and the regulations issued thereunder.

(k) Borrower has filed, or caused to be filed, all tax returns which are required to be filed by it, and has paid or caused to be paid all taxes as shown on such returns.

(l) The Burlington Northern Agreement is in full force and effect and has not been modified or amended except as disclosed in writing to Lender, and there exists no event of default thereunder or event which, with the passing of time or giving of notice, or both, would constitute an event of default thereunder.

(m) Borrower has fee title to each of the Vehicles and holds such title free from any and all liens (other than as created pursuant hereto and other than as previously disclosed in writing to Lender) and taxes. Each Vehicle is properly titled and licensed in accordance with all applicable law.

(n) Borrower's principal place of business is in Guernsey, Wyoming, and the Vehicles are primarily located and operated in Wyoming. The Vehicles are used and operated only in the states of Colorado, Nebraska, Wyoming, South Dakota, Montana and Kansas.

(o) Borrower is not in default, in any manner which would materially and adversely affect its business properties, assets, operations or condition (financial or otherwise), in the performance, observance or fulfillment of any of the obligations, covenants or conditions set forth in any agreement or instrument to which it is a party or by which it or any of its properties, assets or revenues are bound.

Section 5.2 Continuing Effect. Borrower further represents and warrants that the foregoing representations and warranties, as well as all other representations and warranties of Borrower to Lender relative to the Loan and this Agreement, shall be true throughout the term of this Agreement.

ARTICLE VI

COVENANTS OF BORROWER

Section 6.1 Affirmative Covenants. Unless Lender shall otherwise consent in writing, so long as the Loan shall remain unpaid, Borrower shall:

(a) **Compliance with Laws, Etc.** Comply in all material respects with all applicable laws, rules, regulations and orders, such compliance to include, without limitation, maintaining all licenses and permits required by state and federal entities for the ownership, use and operation of the Vehicles, and paying before the same become delinquent all taxes, assessments and governmental charges imposed upon it or upon its properties except to the extent contested in good faith.

(b) **Reporting Requirements.** Furnish or cause to be furnished to Lender the following:

- (i) As soon as practicable, and in any event within 30 days after the end of each calendar month, financial reports of Borrower, consisting of a balance sheet, income statement and such other financial reports as Lender may reasonably request, certified as true and correct by Borrower's manager(s);
- (ii) As soon as practicable, and in any event within 60 days after the end of each calendar year, financial reports of Borrower, consisting of a balance sheet, income statement and such other financial reports as Lender may reasonably request, certified as true and correct by Borrower's manager(s);
- (iii) As soon as practicable, and in any event within 30 days after the end of each calendar year, financial statements of each Guarantor, consisting of a balance sheet, income statement and such other financial statements as Lender may reasonably request, certified as true and correct by the respective Guarantors;
- (iv) Written notice promptly upon becoming aware of any action, suit or proceeding pending or threatened against or affecting Borrower which, if determined adversely, could

materially and adversely affect Borrower or its business, assets or operations; and

- (v) Such other information respecting the condition or operations, financial or otherwise, of Borrower as Lender may from time to time reasonably request.

(c) Financial Covenants. At all times, maintain the following standards:

- (i) A ratio of Current Assets to Current Liabilities which is equal to or greater than 1:1;
- (ii) Members' Equity equal to or greater than \$600,000.00; and
- (iii) A ratio of Indebtedness to Members' Equity which is not greater than 3:1.

(d) Inspection Rights. At any reasonable time, and from time to time, permit Lender, or Lender's agents or representatives, to examine and make copies of and abstracts from the records and books of account of, and visit the properties of, Borrower, to inspect the Vehicles, and to discuss the affairs, finances and accounts of Borrower with its representatives, officers, directors or partners.

(e) Preservation of Existence. Maintain Borrower's existence and good standing in the State of Wyoming and its authority or qualification to do business in each state in which the Vehicles are operated and any other state in which Borrower's business requires qualification, and promptly and properly comply with all laws, statutes, ordinances and governmental regulations applicable to it or any of its asserts, operations and transactions.

(f) Change of Principal Place of Business. Promptly notify Lender if changes are made in the location of Borrower's principal place of business.

(g) Use of Vehicles in Other States. Furnish Lender with not less than twenty (20) days' prior written notice if Borrower contemplates moving any of the Vehicles to, or operating any of the Vehicles in, a state other than Wyoming, Colorado, Nebraska, South Dakota, Montana or Kansas on either a permanent or temporary basis.

(h) Maintenance of Vehicles, Etc. Maintain and preserve the Vehicles and all of Borrower's other properties

necessary or useful in the proper conduct of its business in good working order and condition.

(i) Keeping of Records and Books of Account. Keep records and books of account, in which complete entries will be made in accordance with GAAP, reflecting all financial transactions of Borrower.

(j) Copies of Filings. Promptly submit to Lender copies of any filings made with state officials pertaining to Borrower's limited liability company status and qualification to do business.

(k) Insurance. Maintain or cause to be maintained, with financially sound and reputable insurance companies or associations, insurance which insures the Vehicles against (i) all risk of loss, damage, destruction, theft, or any other casualty or risk, covering the Vehicles, in an amount approved by Lender, but in no event less than the full replacement cost thereof, (ii) comprehensive general liability insurance covering the Vehicles and Borrower, in an amount not less than \$ 2,000,000 ~~per occurrence for each Vehicle and \$~~ in the aggregate for each Vehicle, for bodily injury and/or property damage liability, or such higher amounts as Lender may reasonably require, (iii) collision coverage in an amount not less than \$ 1,375,000 per occurrence for each Vehicle and (iv) workers' compensation insurance in accordance with the requirements of applicable law, which policies of insurance maintained pursuant to this subsection shall provide standard endorsements or clauses naming Lender as loss payee (with respect to property insurance) or additional insured (with respect to liability insurance). All required policies shall provide for ten (10) days' written notice to Lender prior to the effective date of any cancellation or modification thereof. The original or a certified copy of each insurance policy shall be delivered to Lender, and such delivery will constitute an assignment to Lender, as further security for the Obligations, of all unearned premiums returnable upon cancellation of any such policy.

series
(1)

(l) Further Assurances. Promptly cure any defects in the execution and delivery of this Agreement, the other Loan Documents and any other instrument or agreement described herein or therein and immediately execute and deliver, upon request of the Lender, all such further documents or instruments as may be required by Lender to carry out the covenants of Borrower herein.

(m) Permits and Licenses. Do or cause to be done all things necessary to obtain and renew all permits, licenses and other approvals required by any federal, state or local agency for operation of the Vehicles, including without limitation, all permits, licenses and approvals required by the Federal Railroad Administration.

(n) Safety Requirements. Comply in all respects with all safety requirements of all federal, state and other governmental and regulatory authorities having jurisdiction over Borrower's business and operation of the Vehicles, including, without limitation, the Federal Railroad Administration.

(o) Software. Make all filings required by law to protect the proprietary nature of any copyrights which Borrower may have with respect to any software used or usable in connection with the Primary Vehicle, and furnish Lender with any and all codes required or usable to access any such software.

(p) Burlington Northern Agreement. At all times fully perform and comply with all of its obligations under the Burlington Northern Agreement.

(q) Burlington Northern Consent. Not later than January 31, 1991, furnish to Lender a letter from Burlington Northern, (i) acknowledging Lender's right to succeed to Borrower's interest under the Burlington Northern Agreement, (ii) stating that the Burlington Northern Agreement is in full force and effect and that there exists no event of default thereunder or event which, with the passing of time or the giving of notice, or both, will constitute an event of default thereunder, and (iii) otherwise in form and substance satisfactory to Lender.

Section 6.2 Negative Covenants. Unless Lender shall otherwise consent in writing, so long as the Loan shall remain unpaid, Borrower shall not:

(a) Encumbrances. Create, incur, assume, permit or suffer to exist any lien on any of the Collateral.

(b) Sale of Collateral. Sell, convey, lease (except as provided under the Burlington Northern Agreement), transfer or otherwise dispose of all or any of the Collateral.

(c) Use of Vehicles. Move any of the Vehicles to, or operate any of the Vehicles in, a state other than Wyoming, Colorado, Nebraska, South Dakota, Montana or Kansas on either a permanent or temporary basis.

(d) ERISA Compliance. At any time permit any plan maintained by it under ERISA to (i) engage in any "prohibited transaction" as such term is defined in Section 4975 of the Internal Revenue Code of 1986, as amended; (ii) incur any "Accumulated funding deficiency" as such term is defined in Section 302 of ERISA; or (iii) terminate any such Plan in a manner which could result in the imposition of a lien on the property of Borrower pursuant to Section 4068 of ERISA.

(e) Nature of Business. Make any substantial change in the nature of its business as such business is now conducted.

(f) Affiliate Indebtedness. Upon the occurrence of and during the continuance of any Event of Default, pay any indebtedness owing by Borrower to or for the account any of its members, managers, officers or employees.

(g) Burlington Northern Agreement. Amend or modify the Burlington Northern Agreement or take any actions which may result in termination of the Burlington Northern Agreement prior to its stated expiration date.

(h) Change in Members. Permit any substitution of the members who hold Borrower's Ownership Interests.

(i) Liquidation, Etc. Liquidate, dissolve, merge into another entity or sell all or substantially all of Borrower's Assets.

ARTICLE VII

EVENTS OF DEFAULT AND REMEDIES

Section 7.1 Events of Default. If any of the following events (the "Events of Default") shall occur and be continuing:

(a) Borrower shall fail to pay any installment of principal of or interest on the Note when due or within ten (10) days thereafter; or

(b) Any representation or warranty made by the Borrower or any of its representatives under or in connection with any Loan Document shall prove to have been inaccurate in any material respect when made; or

(c) Borrower shall fail to perform or observe any other term, covenant or agreement set forth in any Loan Document which Borrower is to perform or observe (other than the obligation to make payments under the Note or the other Loan Documents), and any such failure shall remain unremedied for a period of ten (10) days after written notice thereof shall have been given to Borrower; or

(d) Any of the Vehicles is lost, stolen, damaged, destroyed or seized; or

(e) Borrower fails to furnish Lender with the original vehicle titles for the Test Vehicles, free from all liens (except the liens created hereunder) on or before January 31, 1991; or

(f) The Burlington Northern Agreement is terminated prior to its stated expiration date; or

(g) Borrower or either Guarantor shall admit its inability to pay its debts, or shall make a general assignment for the benefit of creditors, or shall generally not be paying its debts as such debts become due, or any proceeding shall be instituted by or against it seeking reorganization, arrangement, adjustment, or composition of it or its debts under any law relating to bankruptcy, insolvency or reorganization or relief of debtors, or seeking appointment of a receiver, trustee, or other similar official for it or for any substantial part of its property and, if instituted against it, shall remain undismissed for a period of thirty (30) days; or

(h) There shall occur any event of default under any other Loan Document;

then, and in any such event, Lender may, without notice to Borrower (except such notice as may be expressly provided herein), exercise any of the remedies set forth in Section 7.2 of this Agreement.

Section 7.2 Remedies. Immediately upon or at any time after the occurrence of an Event of Default, Lender may exercise any remedies available at law or in equity, including but not limited to those set forth in this Section and those set forth in the other Loan Documents, in such sequence or combination as Lender may determine in its sole discretion:

(a) Declare the Note, all interest thereon and all other amounts payable under this Agreement and the other Loan Documents to be immediately due and payable, whereupon the Note, all such interest and all such amounts shall become and be due and payable, without presentment, demand, protest or further notice of any kind, all of which are hereby expressly waived by Borrower;

(b) With or without accelerating the maturity of the Note and the other Obligations, sue from time to time for any payment due under any of the Loan Documents, or for money damages resulting from Borrower's default under any of the Loan Documents;

(c) Exercise all of its rights with respect to the Cash Deposit, as described in subsection 3.3(e) of this Agreement;

(d) Enter upon any premises where any of the Vehicles might be located to take possession thereof, either personally or by means of a receiver appointed by a court of competent jurisdiction, using all necessary force to do so, with no liability whatsoever to Borrower as a result of such repossession, and Borrower hereby expressly waives any right of action or claims whatsoever that Borrower may have against Lender, its agents or employees resulting from such repossession of the Vehicles or effort to repossess the same;

(e) Foreclose or otherwise enforce the security interests granted hereunder and under the other Loan Documents, in whole or in part, by any available judicial procedure;

(f) At Lender's option, use, operate, manage and control the Collateral in any lawful manner;

(g) Collect and receive all rents, income, revenue, earnings, issues and profits from the Collateral;

(h) Maintain, repair, renovate, alter or remove the Collateral as Lender may determine in its sole discretion;

(i) After notification, if any is provided for herein or required by law (unless waived), dispose of, at the office of Lender, on the premises of Borrower, or elsewhere, all or any part of the Collateral, as a unit or in part, by public or private proceedings, and by way of one or more contracts (it being agreed that the sale of any part of the Collateral shall not exhaust Lender's power of sale, but sales may be made from time to time, and at any time, until all of the Collateral has been sold or until the Obligations have been paid and performed in full; and it being further agreed that it shall not be necessary to exhibit any of the Collateral at any such sale, but if Lender wishes to do so, Borrower will assemble, or cause to be assembled, at its expense, the Collateral at such place or places as Lender shall designate in its sole discretion);

(j) Buy the Collateral, or any part thereof, at any public sale;

(k) Buy the Collateral, or any part thereof, at any private sale if such Collateral is of a type customarily sold in a recognized market or is of the type which is subject to widely distributed standard price quotations;

(l) At its discretion, retain the Collateral in satisfaction of all or part of the Obligations whenever the circumstances are such that Lender is entitled to do so under the Uniform Commercial Code or otherwise (provided that such retention shall not be deemed satisfaction of the Obligations unless Lender so notifies Borrower in writing);

(m) Exercise any and all other rights and remedies granted to a secured party under the Uniform Commercial Code and not otherwise specified herein; and/or

(n) Perform or attempt to perform (but without obligation to do so) any of Borrower's covenants, duties, obligations, liabilities or agreements hereunder or with respect to any of the Collateral.

Without limiting any of the rights and remedies set forth above, if any rights and remedies exercised by Lender result in Lender incurring any costs and expenses, Borrower shall be solely liable for such costs and expenses, and all such amounts shall be added to, and become a part of, the Obligations. By way of example, and not limitation, if Lender shall wish to relocate the Vehicles in connection with its exercise of its rights and remedies, Borrower shall be solely liable for all costs and expenses of any nature whatsoever incurred by Lender to relocate the Vehicles to a location designated by Lender.

Section 7.3 Reasonable Notification. Reasonable notification of the time and place of any public sale of the Collateral, or reasonable notification of the time after which any private sale or other intended disposition of the Collateral is to be made, shall be sent to Borrower and to any other person entitled under the Uniform Commercial Code to notice; provided that if any of the Collateral threatens to decline speedily in value or is of the type customarily sold on a recognized market, Lender may sell or otherwise dispose of the Collateral without notification, advertisement, or other notice of any kind. It is agreed that notice sent or given not less than five (5) calendar days prior to the taking of the action to which the notice relates is reasonable notification and notice for the purposes of this Section 7.3.

Section 7.4 No Waiver, Remedies. No failure on the part of Lender to exercise, and no delay in exercising, any right under any Loan Document shall operate as a waiver thereof; nor shall any single or partial exercise of any right under any Loan Document preclude any other or further exercise thereof or the exercise of any other right. The remedies provided in the Loan Documents are cumulative and not exclusive of any remedies provided by law.

ARTICLE VIII

MISCELLANEOUS

Section 8.1 Amendments, Etc. No amendment or waiver of any provision of the Loan Documents, and no consent by Lender to any departure by Borrower therefrom, shall in any event be effective unless the same shall be in writing and signed by the Lender, and then such waiver or consent shall be effective only in the specific instance and for the specific purpose for which given.

Section 8.2 Notices, Etc. All notices which are required or which may be given in connection with this Agreement or any of the Loan Documents shall be effective when given in writing by delivery in person or three (3) Business Days after the same are sent by certified mail, return receipt requested, with postage prepaid to the parties at the following addresses:

If to Lender:

Colorado National Leasing, Inc.
950 Seventeenth Street
Suite 2400
Denver, Colorado 80202
Attention: Edward J. Vanderslice

With a copy to:

Kathleen M. Bottagaro, Esq.
Otten, Johnson, Robinson, Neff & Ragonetti, P.C.
950 Seventeenth Street, Suite 1600
Denver, Colorado 80202

If to Borrower:

SSTECH Railway Technology
P.O. Box 104
Guernsey, Wyoming 82214
Attention: Donald S. Searle

With a copy to:

Peter Tyler
c/o Hickey & Evans
1712 Carey Avenue
Cheyenne, Wyoming 82003-0467

Section 8.3 Prior Understandings. This Loan Agreement supersedes all prior understandings and agreements, whether written or not, between the parties hereto relating to the transactions provided for herein.

Section 8.4 Participation. Lender may, in its sole discretion and without notice to Borrower, sell or transfer participation interests in the Loan, in such amounts or percentages, and to such persons or entities, as Lender desires. Such sale or transfer of participation interests shall not relieve Borrower of any obligation under the Loan Documents.

Section 8.5 Binding Effect; Assignment. This Agreement shall be binding upon and inure to the benefit of Borrower and Lender and their respective successors and assigns, including participants, if any, with Lender, except that Borrower shall not have the right to assign any rights hereunder or any interest herein without the prior written consent of Lender. Without limiting the foregoing, Borrower acknowledges that Lender may freely assign all of its rights under the Loan Documents.

Section 8.6 Governing Law. This Agreement is entered into and shall be performed in Denver, Colorado, and shall be subject to and construed and enforced in accordance with the laws of the State of Colorado.

Section 8.7 Further Assurances. From time to time, Borrower will execute and deliver to Lender such additional documents and will provide such additional information as Lender may reasonably require to carry out the terms of this Agreement and be informed of the status and affairs of Borrower.

Section 8.8 Severability. If any provision of this Agreement shall be held invalid under any applicable laws, such invalidity shall not affect any other provision of this Agreement that can be given effect without the invalid provision, and, to this end, the provisions hereof are severable.

Section 8.9 Counterparts. This Loan Agreement may be executed in any number of counterparts, each of which shall be deemed to be an original, and all of which shall together constitute but one and the same instrument.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the date first above written.

BORROWER:

SSTECH RAILWAY TECHNOLOGY, a Wyoming limited liability company

By: Donald S. Searle, Manager

LENDER:

COLORADO NATIONAL LEASING, INC.,
a Colorado corporation

By: Edward J. Vanderslice
Title: Vice President

STATE OF COLORADO)
COUNTY OF DENVER) ss.

The foregoing instrument was acknowledged before me this 20th day of December, 1990 by Donald S. Searle as Manager of Sstech Railway Technology, a Wyoming limited liability company.

Witness my hand and official seal

Carri D. Herrera
Notary Public

My commission expires 1-31-94

STATE OF COLORADO)
COUNTY OF DENVER) ss.

The foregoing instrument was acknowledged before me this 20th day of December, 1990 by Edward J. Vanderslice as Vice President of Colorado National Leasing, Inc., a Colorado corporation.

Witness my hand and official seal

Carri D. Herrera
Notary Public

My commission expires 1-31-94

LIST OF EXHIBITS

Exhibit A Description of Primary Vehicle

Exhibit B Description of Test Vehicles

EXHIBIT A

Primary test vehicle 9007 is a self-propelled, diesel-powered, fully thermally insulated, heated and air-conditioned 4-wheel vehicle of the following dimensions:

Length	7.60 m
Width	2.85 m
Height above rail	3.60 m
Wheelbase	3.80 m
Weight (laden)	16 tons

Performance characteristics are as follows:

- (a) Test speed 40 kph *in both forward and reverse directions.*
- (b) Run light travelling speed is 70 kph in both forward and reverse directions.
- (c) Detection capabilities are such as to meet or exceed defect detection specifications for all nominated defect types.
- (d) Water capacity is 700 l, or enough for 350 kms continuous testing. A separate calcium chloride brine solution mixing and storage system is incorporated, along with domestic water storage and heating.
- (e) Fuel capacity is 600 l, giving a testing range of 300 km approximately. Fuel required is normal locomotive grade diesel fuel oil.

Mechanical details of test car are as follows:

The main chassis of the railcar comprises a set of steel channel girders to which the cab is rubber mounted. The rail wheels (850mm diameter) are on two axles connected to the chassis by both rubber "marshmallow" springs and chevron packs which provide lateral stability. The propelling engine is a 160 HP air-cooled VM diesel which drives a swash-plate piston pump which supplies oil to two variable displacement piston swash-plate hydraulic motors, one on each axle. Braking is by means of air-over-hydraulic actuated disc brakes on each axle.

The auxiliary engine is a 55 HP air-cooled VM diesel driving a 10 KVA alternator to supply power for detection equipment and heating. The engines, batteries (4 x 12v units for 12v and 24v car system DC power), fuel, oil and water tanks, and air compressors (4, for both system air and air-conditioning) are mounted on main chassis extensions and slung underframe. All tanks and sumps are electrically heated. Car AC power is 240v, 50 Hz and two 3 KW step up transformers for outside 115 Vac power are provided.

The body is thermally insulated and the cabin provides seating for seven people. Driver's controls and full instrumentation are provided at both ends of the vehicle. Refrigerator, freezer, microwave oven, electric appliances, sink and kitchen bench are all included along with cupboard space and work benches with other external and internal storage.

Details of test equipment are as follows:

Test Carriage

- (a) The platform for the ultrasonic sensors is a hydraulically and pneumatically controlled test carriage slung under the frame "amidships".

The test carriage guide wheels are of steel-rubber-steel sandwich construction to reduce acoustic vibration being carried into the test carriage. The test carriage is made to track accurately along the rail by pneumatic pressure generated by the gauge correction rams holding the guide wheel flanges against the rail at all times.

Weight of the test carriage is approximately 1 ton. It is connected to the rail-car by a towing arm, with large rubber bushes to insulate the carriage from railcar vibrations.

EXHIBIT A (continued)

The test carriage has a center frame attached to the railcar by the towing arm and a wire hoist. To each side of this center frame is a side frame, carrying the main wheels and the wheel-probe housings. Each side frame is attached to the center frame by a pair of parallel swing arms, so that it can swing away from the center frame while staying parallel to it.

The two side frames are connected to each other by two 50 mm diameter pneumatic rams, so that they can be pressed out until the test-carriage rail-wheel flanges are firmly against the gauge faces of the rails. (These rams are called the Gauge Correction Rams since they permit adjustment of the test carriage for changes in gauge of the railway track).

On each side frame is a saddle housing carrying three probe-wheels or roller search units. The probe-wheels are carried in callipers, which fit into calliper slides on each saddle housing. The callipers incorporate a spring suspension to ensure constant contact with the rail, regardless of dipped joints, corrugation, saddling, etc. The saddle housing is connected to the side frame by swivel bushes and controlled by two hydraulic rams.

One of these rams-tilts (cants) the probe-wheel saddle housing in relation to the side frame, so permitting the wheel probes to be adjusted vertically to line up with the rail cant.

The second ram moves the probe-wheel housing in or out in relation to the side frame, so permitting the wheel probes to be tracked across the rail until they are centred over the web.

Both these rams are controlled by the operator using the buttons indicating required direction of motion. Each operation of the button achieves a fixed incremental movement of the appropriate ram.

The probe wheels themselves comprise a central stationary axle carrying a transducer mounting block, surrounded by a rotating polyurethane-tired wheel filled with fluid. There are two types of probe-wheel, a 37 degree and a 70 degree wheel, determined by the type of transducer mounting block installed. Beam direction is determined by transducer orientation in the mounting block. Both types of wheels include 0 degree transducers as well as the angle probes. All angles refer to the angle of divergence between the beam direction within the steel and vertical.

Electronic Systems

- (b) The ultrasonic signals are sourced from electronic flaw detector racks on board the car. These racks also process the returning signals through logic and counting circuitry before supplying output to an 8-channel heated stylus chart recorder for the operator to monitor, and data for the separate computer to process. The operator acts as a chairman between these inputs.

The system is timed by electronic pulses provided every 1mm of travel of the machine from shaft pulse encoders. This pulse train also provides the basis for flaw sizing.

Audible alarm modules alert the operator when suspect flaws are detected. Rail mark modules are used to trigger a paint spray device when an alarm is detected by the analog flaw detectors.

Monitoring of equipment performance and adjustment is facilitated by two Tektronix CRT displays which are push button selectable by the operator to enable him to visually monitor the "A" scan image of the chosen channel.

Details of the electronic flaw detector system are as follows:

As well as inputs from the four probe-wheels, the system has an input from a distance-encoding system on a test carriage wheel. This provides an electronic pulse for every 1 mm of rail travel of the machine. This 1mm pulse train is used to time the operation and also provides the basis for longitudinal flaw sizing. The timing is achieved by electronically dividing the pulse train, thereby producing an output which is the system resolution or PRF. Normal testing PRF is about 2.7 KHZ.

EXHIBIT A (continued)

Each transducer within the wheel probe will be coupled to its own channel of electronic flaw detection equipment. All channels are mounted into a standard rack configuration.

Controls are accessible from the front panels. Each electronic channel comprises a row of plug-in printed circuit cards. Their construction is of fiberglass board using double sided printing and plated through holes. The circuit tracks are all tinned and external connections are achieved using 26 gauge wire wrap (modified) techniques.

The modules are itemized and described hereunder:

1. High energy pulse transmitter type US-PG-8
2. Wide base high gain amplifier type US-AMP-9A
3. Quantiser Modell type US-TH-5
4. Gate generator and positioner type US-MO-6
5. Multi pulse noise filter type US-PCV-1R
6. Alarm state detector type US-AD-7
7. Analogue amplifier type US-AA-7
8. The audible alarm module US-AAM-13
9. Rail mark module US-RM-1
10. Time Base Generator Module US-TBG-3
11. Buffer Module (master) US-BC-12
12. Buffer Module (slave) US-BC-11
13. Echo and Gate Timing Module

Functional Description

The **high energy pulse transmitter** is used to generate a 500 volt pulse with a rise time better than 10 nano seconds. This is used to excite the piezo electric transducer causing it to physically excure, thus generating a short pulse of sound energy which is conveyed into the work piece via the fluid in the wheel and the wheel rail couplant. The PRF of the transmission is synchronized with the speed of the test car. This enables the longitudinal length and position of the flaws to be determined.

The **wide band high gain amplifier** is designed specifically for the amplification of ultrasonic impulse signals applicable to the testing of integrated circuit components. A suppression control and a gain control are accessible on the front panel and can be modified by the operator. A variable gain of up to 80 dB is used. A display of the amplified signal received can be viewed on the cathode ray oscilloscope via the appropriate switch selection.

The **quantising module** receives the amplified signals from the amplifier and compares their magnitude with a pre-set threshold level. This provides the means of discriminating between low level noise inputs and general background "hash" which is present in ultrasonic systems. The threshold level is set by the operator to the optimum value. The control is accessible on the front panel.

The **gate generator and positioner** is included to ensure that the required areas within the rail steel are being searched. This is achieved by gating in the relevant portions of the beam path using the time base as a reference. The gate positions and width controls are accessible on the front panels and can be modified by the operator. The gate can be viewed, super-imposed on the amplifier trace, on the cathode ray oscilloscope via the appropriate switch selection. The fine position of the gate is controlled by front panel rotary control but the coarse control is controlled by internal switches.

The **multi-pulse noise filter** is included in the package as a means of eliminating spurious noise spikes from the assessment. This module is designed to associate each possible flaw input with a given transmission pulse and ensure an unbroken chain of pre-selectable events prior to an input being recognized as a flaw—the theory being that with a given probe beam spread and PRF resolution, any "one millimeter" flaw will produce a given number of sequential echoes. The random noise component rarely presents itself reliably any more than three times in succession when cross referenced to the pulse repetition rate. The number of counts can be pre-set by the operator via the controls accessible on the front panel.

In the 37 degree channel, the primary task is to detect cracked bolt holes. These do not present an unbroken train of echoes. Instead, an echo is received from the "normal" of the bolt hole, then falls below threshold as the slop-

ing part of the hole is traversed, then rises again along the crack. This loss of signal would cause the pulse counter to reset, were there not a set of internal switches in the module which permit a preselected number of zero-echoes to be accepted without resetting the alarm counter.

The **alarm state detector** will provide an output when a flaw exceeds the criteria which is governed by the setting of the control on the modules previously described. This output is used to sound an alarm and/or mark the rail. Front panel indicators are provided to show an observer what events are taking place.

The **analogue amplifier** is used to condition the receiver output to provide a signal compatible with the strip chart recorder. This is necessary because the signals received from the gated area in the 'A' scan representation are too short in duration for the chart recorder pens to respond. Therefore this module time-stretches the signal while retaining the detected amplitude ratio and provides a compatible output impedance to drive the recorder.

The **audible alarm module** is fitted with a sounding device which excites when a flaw is detected. This is cancelled by the operator as confirmation of his attention thereto. Only one of these modules is necessary for each rail.

The **rail mark module** is used to trigger the paint spray device when an alarm is detected by the analog flaw detectors.

Timing

A. Ultrasonic

Sound waves travel as compression waves at approximately 1.6 km/s in the probe-wheel fluid. In steel, two types of propagation are possible, compression waves and shear waves. The former travel at about 5.9 km/s in steel. Shear waves travel at 3.23 km/s in steel, and do not travel through fluids.

Because of these velocities, Snell's Law says that any beam at more than some 15 degrees from the vertical will have its compression wave totally reflected off the liquid/steel. Consequently, the zero beam is a compression wave entirely, while both the 37 and 70 beams are compression in the fluid and shear in the steel.

The transducers are each about 70mm from the rail, so sound takes some 44 micro seconds to reach the rail. A compression wave then takes about 31 micro seconds to reach the foot of the rail, and a shear wave takes about 45 micro seconds to reach the bolt holes in the web. Thus the two-way transmission time of interest for the zero beam is about 150 micro seconds, and 180 for the 37 degree beam.

When the car is travelling at 40 kph, it travels 4mm in 360 micro seconds.

B. Electronic

System timing is controlled by the **Master Time Base Generator** using either pulses from the **Shaft Encoder**, or an internal clock.

The **Master Time Base Generator** controls the right flaw detection rack, and sends signals to the **Slave Time Base Generator** which controls the left flaw detection rack.

Each **Time Base Generator** generates a **Master Trigger** signal from the shaft encoder pulse, which is a square wave at the **Shaft Encoder** pulse frequency. This is passed to the **Buffer Module**, where the positive going pulse generates a signal T1 forward-shooting channels. A pulse TTP (Transmit Trigger Pulse) is then generated which actually triggers the transmission. T1 also is sent to trigger a time in the **Entry & Gate Timing** module.

The received signal is then gated by the computer start gate in the **Time Base Generator**, and the entry echo is detected (if present). This signal is used to trigger the Zero, and the Forward 70, Monitor Gates, to initiate (after some operator-set delay) the search gates.

The signal is also sent to the **Entry & Gate Timing** module, so that this module can store the delay of the entry-echo, in order to trigger the back-shooting 70 degree search gates as will be shown below.

The negative going pulse generates a delayed signal T2 which enables the transmission of the two backshooting channels. This time **Transmit Trigger Pulse** generates the two backshooting pulses, but the 70 degree search gate in the **Monitor Gate Module** is triggered at an operator-set delay after the previously mentioned signal from the **Echo & Gate Timing Module**.

At 40 kph, T1 occurs every 360 micro seconds, and T2 occurs at the same rate but delayed by 180 micro seconds.

As shown above, the entry-echo, off the wheel material and the rail top surface, is detected by the Time Base Generator Module, and passed to the Entry Gate Module. The result triggers, via delay networks in the Gate Generator Modules, the search gates. Thus the search is started at a fixed interval after the entry echo, not after the transmission. This arrangement is necessary to allow for variations in wheel diameter due to movement of the test carriage over the rail.

The Echo & Gate Timing Module also sends IF (Interface) Start to the computer, to trigger all the interface timers.

In the analogue system, alarm detection is achieved by the pulse generator counting the number of successive occurrences of a threshold being exceeded during an open gate period. This causes an Audible Alarm to be generated, and also opens the Analog Amplifier Circuits to permit the actual amplitude of the alarming signal to be passed to the chart recorder via appropriate drivers.

In the computer, alarms are detected by any signal exceeding threshold.

Computer and Peripherals

Computer

The computer system uses a Computer Automation Industries LS1-2 computer, with real-time clock, serial I/O, Power-fail Restart, Auto-load facility, and vectored interrupts with a priority chain. It uses 16 bit words, and has 32K MOS memory with battery back-up.

Interfaces: Left rail primary, Left rail secondary, Right rail primary, Right rail secondary, Odometer and Cassette magnetic tape unit.

The program is written in Assembly Language.

Magnetic Tapes

There are two tape recorders, a cassette system for program storage and a high speed 9-track recorder for data acquisition. The cassette system is as follows:

TEAC MT-2	
Tape Speed	15 IPA +/- 3% or 45 IPS +/- 4%
Data Density	800 BPI, PE, single track
Recorder Dimensions	105(H) x 120 (W) x 91 (D) mm.

The magnetic Tape Recorder for storage of data from flaw-detection operations is a Digi Data 9 track 1600 BPI machine.

Hardware Description

Components

The following card components are mounted in a rack:

- Main Computer Card.
- Option Card mounted piggy-back on the main computer card.
- 32K memory card.
- Interface board.

The Option Card has a connector for the Tandy 102 PC and another for the Interface board.

Program is read in off a cassette tape, and program operation is initiated from the computer front-panel touch-sensitive controls. When running, the flaw-detection program is controlled by the keyboard of the Tandy 102, and obtains its data from the flaw detection racks through the Interface Card.

Interface Board

The Interface Board interconnects the analogue flaw detection circuitry to the computer. Each transmission triggers a set of timers on the board, and an echo exceeding threshold in any channel will generate an interrupt signal to the computer through this interface board. The computer, when interrupted, reads this timer and so can measure the signal path length to the echo source. Then by simple trigonometry it can calculate and report the depth of the source in the rail.

EXHIBIT A (continued)

The Interface Board also contains the Drivers Odometer Reset interrupt generator circuit, and an odometer counter. The counter is incremented (or decremented) by successive pulses from the shaft encoder, and the computer can at any time read, or reset the counter to obtain, or change, distance information.

The Interface Board also contains a means for the 10-button keypad to be monitored by the computer, so that the operator can cause selected inputs to the computer. The program can then be set to take any chosen action when one of these keys is pressed.

The Interface Board also contains the hardware to interface the computer to the Magnetic Tape Recorder.

Ten-button Keypad

The 10-button keypad is used to signal the computer about some operator information or command. It functions by having ten keys, each of which is connected to an input of an 8-input priority encoder chip, with some additional gates to cope with the remaining two buttons. When a button is pressed, an interrupt is generated by the Gate Set logic, and the computer reads the encoder value of the button pressed.

What action is then taken by the computer is entirely determined by program. For instance, the computer can be caused to print messages like "crossing," or it can be "toggled" between display or run modes.

The computer, when running, sits in a "Main Loop," in which it sequentially performs a number of functions, then starts again. At any time, any of a number of external functions can interrupt this main loop, and cause a jump to a separate Interrupt Service Routine. On completion of this ISR, the main loop continues from where it was interrupted.

Usually the ISR will read data into memory, perhaps perform some checking on that data, then set a flag so that the main loop can tell an interrupt has occurred. The main loop will include a step to check each interrupt flag, and will perform the lower-priority tasks made necessary by the interrupt. Obviously a problem may arise when interrupts occur so frequently that the main loop is unable to service all the accumulating flags, and normally a buffer storage is provided so that a number of flags can accumulate before overflow occurs. It is then up to the programmer whether to abort the program, or just print a warning message, when the buffer overflows.

Interrupt Priority

Interrupts are priority-connected, so that lower-priority ISR's can be interrupted by higher-priority interrupts but not vice versa.

Flaw Detection Program Interrupts

In the flaw detection program, the highest priority interrupt is that servicing the Magnetic Tape Recorder. Then there are six "flaw detected" interrupts, and the Driver's Odometer Reset Interrupt. Lowest priority is the 10-keyboard interrupt.

The six Flaw Detected Interrupts are Left and Right Primary, Secondary, and Tertiary Interrupts, representing 0 degree, forward 70 degree, and back-shooting 70 degree.

Magnetic Tape Recorder Interrupt Service Routine

This is a standard tape handler routine, used to transfer data character by character to the tape recorder.

Flaw Detection ISR

Each of the six flaw detection channels monitored by the computer has a timer and an interrupt generator. When the interrupt is received, the ISR causes the time to read and the time to be converted to depth within the rail. The first received interrupt opens a New Defect File, and sets up the parameters which will define the end of the defect. It also reads to odometer, clears various flags, etc. The data is put into the defect file, and the ISR exits to Main Loop.

The hardware interrupt generator is arranged so that all subsequent transmissions will generate interrupts, either when a flaw is detected or when the time times out at end of the receive period. This latter occurrence generates Null Data.

This Null Data is used by the computer program to detect the end of the flaw. In the zero beam, five successive nulls are taken as end of flaw. In the 70 beams, a more complex technique is used as described later.

All Null and Flaw data received from subsequent transmissions is added to the defect file, until end of flaw is

detected. Certain counters are incremented depending on the depth of each echo.

When End of Flaw is detected, the ISR for the final interrupt evaluates all the data now in the Defect File, and generates appropriate messages containing location, size and category of the defect. This message is put into a Message Buffer, and a flag is set to tell the Main Loop that a message is waiting. The ISR then resets the interrupt generator so that subsequent null data will not generate an interrupt. It then clears the Defect File, and exits to the Main Loop.

Primary Interrupt

The primary (zero degree) interrupt locates the defect as being:

- a) Below Minimum Rail Height—assessed as Loss of Backwall Echo.
- b) Between Max. and Min. Bolt Hole Height, and bolthole switch pressed—assessed as a bolthole, or hole flaw, depending on length.
- c) Below the Head—assessed as Web Defect.
- d) Below the compression zone—assessed as Head Defect
- e) Part in the Head and part in the Web—assessed as Head/Web Defect.
- f) In the compression zone—ignored.
- g) Too fragmented and too short—ignored.

Secondary & Tertiary Interrupts

The Secondary and Tertiary ISR's are virtually identical.

Data is accumulated until 3 consecutive Null Data are received. However, as this may be due to discontinuities in the Transverse Head Defect, this is not taken as end of defect directly. Instead, at this point the program assesses how much longer the defect could be if normally oriented, and monitors for that length of search. Once the normally oriented defect would have disappeared into the compression zone, or into the web, the ISR assesses this to be End of Flaw.

If meanwhile, however, further data is received before this point, the flaw is kept open until another 3 Null Data is received and the same process repeats.

On completion, the defect is assessed by its greatest depth below the head, on the assumption that the flaw probably started near the head and may have been poorly oriented near the head.

Computer Printer

The computer allows a detail map to be drawn of the reflectors associated with each individual defect. The suspected type, its recorded data, and the actual kilometerage or mileage location along with any other keyboard entry is printed out on the test car's line printer.

The buffer LCD display on the Tandy (which shows everything that will eventually be printed out) is what is used by the operator in his "chairing" of inputs from both chart recorder and computer.

EXHIBIT B

TV SERIES ULTRASONIC RAIL TEST CARS

<u>Test Car</u>	<u>Make</u>	<u>Model</u>	<u>Year</u>	<u>Vehicle Identification Number</u>
TV 2	Toyota	Landcruiser Wagon	1989	JT3FJ62G8K1112258
TV 3	Ford	Centurion Classic Bronco Wagon	1990	1FMEU15H7LLA74495

General Description

TV 2 HJ60 Toyota, with complete instrumentation package for the continuous testing of rails for fatigue flows.

TV 3 Ford Centurion Classic 150 4WD, with complete instrumentation for the continuous testing of rails for fatigue flows.

Other Information

A standard 4WD is chosen from local suppliers and fitted with over center hydraulic hirail equipment to form the basis of the TV Series test cars. This principle offers a low cost and easily maintainable prime mover carrying the long term warranty of the car manufacturer, the convenience of four wheel drive, and a multitude of country wide service centers.

Further, it offers the convenience of one tie width, on and off tracking capability and road and rail speeds up to 60MPH depending on specific rules and regulations.

In the rail mounted mode the units are safe, proven and highly reliable even after hundreds of thousands of track miles. On and off tracking can be accomplished with one person and the actuation of the rail equipment is by toggle switches. Simple, safe and effective, providing comfort and ease of operation.

EXHIBIT B (continued)

TEST CARRIAGE.

The need for complex adjustable test carriage componentry is eliminated in the TV Series test cars because of the unique sensor configuration used to scan the rail for fatigue defects. The "GLIDE" principle is used, whereby the sensors are propelled in a framework which is retained against the gauge of the rail by gauging plates. This ensures that positive connection to the rail takes place under all rail head worn conditions. The coupling controls are simple and the test carriage arms act as manifolds for the distribution of couplant to the various sensor blocks.

The test carriage is light and is manually secured for run light operation, both on road and rail. Pivot points are located on the axle of the rear hirail wheels and rubber trailer wheels on the other end of the manifold form the frame of the test carriage. This configuration permits forward and reverse testing.

In standard form ultrasonic beaming takes place at:

- * 70 degrees to the vertical, PULSE ECHO MODE in both the forward and reverse directions along the rail.
- * 45 degrees to the vertical, PULSE ECHO MODE in both the forward and reverse directions along the rail.
- * 5 degrees to the vertical, TRANSMIT RECEIVE MODE with the focus of the beam directed to the neutral axis.

TRANSDUCER BLOCKS AND SENSORS

The wedges are constructed from low attenuation plastic and are designed with an all up weight to permit them to glide on the couplant film at test speed. This reduces the actual contact with the rail surface and extends the life of the wedges. Life with proper care should exceed 1000 miles per wedge and are a low cost replacement. The sensors are designed with a broad response envelope to compensate and ensure detection of flaws when lateral wear on the rail head off centers the glide frame. The glide frame can operate effectively even with 3/4 of an inch lateral displacement. The sensors are glued with silicon adhesive and screwed into position on the plastic wedge. Removal of the sensors from the wedge can be achieved using the solvent SST and they can be replaced on new wedges thus reducing cost.

Retaining blocks are cemented onto the top surface of the wedges to restrict the wedges from falling through the glide frame over frogs and in the run light position.

The sensors and configurations used are fully compatible with the electronics and algorithms employed for the detection of most rail fatigue flaws.

Other configurations of the sensors are available for specific flaw detection programs.

The standard configuration is for CWR 115lb/yd to 136lb/yd R CC rail both standard carbon and head hardened chemistry's.

ELECTRONICS.

EXHIBIT B (continued)

The flaw detector used in the TV Series test cars comprises a multichannel ultrasonic system designed to clip onto the steering wheel of the test car when on rail with the steering lock activated. The miniaturization and advanced technology as applied to the ultrasonic test system of the TV series cars, is a world first. In the run light condition the unit is placed in a protective enclosure between the drivers seat and the observer. The size of the unit is approximately that of a brief case and hence the name "Brief Case", therefore very compact, and when servicing is required the unit can be air freighted to the service center with out difficulty. Individual channels for the 70, 45 and 5 degree ultrasonic beaming are displayed for each rail. Controls are recessed to prevent accidental adjustment. A display panel, which profiles the rails on each side and contains "Light Emitting Diodes" positioned to graphically depict the appearance of the flaw in plan view as they are detected, forms the front panel of the flaw detector. As each flaw is detected the various channels collectively draw a plan picture of the defect and alarms are activated to alert the operator. Multifrequency alarms are used to distinguish the channels activated. Rail marks are also activated to locate the defect along the track for easy identification of the position. The profile of the flaw as displayed on the panel is reset to blank, after verification by hand testing has been completed. Adjustments to prevent the constant display of standard interfaces such as bolt holes are available in the system thus leaving the operator to assess flaws with out constant surveillance and concentration. Flaw sizes that are to be detected can be varied to the operators requirement by simple adjustment. Surface flaws that are considered insignificant can be eliminated from the graphics display.

PERFORMANCE

The TV Series Ultrasonic Rail Flaw Detector Cars have the capability of: Detecting rail fatigue flaws in accordance with the requirements of the FRA standards.

Testing can be conducted at speeds up to 22 MPH.

The vehicle has offroad 4WD capability and as such can be driven to remote locations.

On tracking only requires a one tie width road crossing.

The 4WD permits traction in the most adverse conditions and up all grades.

Braking with four wheels on the rail ensures safe handling at road crossings and obstructions.

The unit only requires one operator.

There are few parts to maintain.

EXHIBIT B (continued)

The prime mover can be serviced at any dealership.

The detector unit can be serviced with out expensive dismantling and can be freighted to the service center in a convenient carry case.

OPTIONS AVAILABLE

The following option packages are available to enhance the capability of the basic test car.

- *Computerized reporting and car movement system.
- *Automatic rail marking.
- *Roller search unit for dipped joint examination
- *Track video recording system for permanent record.